

Agriculture and Marine Environments

With wide acceptance of the view that upland agriculture can affect downstream marine environments, Agricultural Research Service scientists are increasingly turning their attention to coastal marine waters. They are particularly concerned about the potential effects of nutrients from agriculture and other sources on the water quality of coastal estuaries such as the Chesapeake Bay.

Livestock manure and fertilizers are excellent sources of essential plant nutrients, including nitrogen and phosphorus. However, excessive application may result in runoff into waterways and ultimately into coastal waters, where they can stimulate "blooms" of undesirable algae. Harmful algal blooms and red tides of microscopic dinoflagellates, along with *Pfiesteria* outbreaks, are becoming an increasingly serious problem around the world, threatening natural fisheries, aquaculture, and human health.

Closer to home, they have caused major fish kills and human health problems in the Chesapeake Bay and Atlantic coastal waters. Excessive growth of algae and aquatic plants in the Gulf of Mexico has resulted in a lifeless area known as the "Dead Zone," created when decomposing plants rob the waters of life-sustaining oxygen.

While it has not been clearly established that agricultural nutrients are responsible for these phenomena, there is scientific consensus that they can be an important contributing factor. Clearly we need to understand the relationship between agriculture and coastal water quality, reduce nutrient levels in livestock manure, and minimize nutrient losses to water and air from fertilizer and during manure handling, storage, and field application.

This is particularly important for areas near the Chesapeake, the Nation's pre-

mier, but threatened, estuary. Agriculture should, and can, be compatible with a healthy Chesapeake Bay.

USDA in general, and ARS in particular, are well positioned to carry out focused research programs whose goal is to better understand and minimize negative impacts of agriculture on coastal environments. ARS currently supports 35 research projects related to effective management of fertilizer and manure nutrients to enhance crop production and protect environmental quality.

Two leading laboratories in this research are the Environmental Chemistry Laboratory in Beltsville, Maryland, and the Pasture Systems and Watershed Management Research Laboratory in University Park, Pennsylvania. Scientists in those labs have developed nutrient management practices for more effective use of nitrogen and phosphorus from fertilizer and manure, gained an understanding of air and water transport of pesticides to the bay, and evaluated the effectiveness of riparian buffers for water quality protection.

ARS has recently stepped up its research related to agriculture and coastal environments. Highlights include:

- Examining, in a new program involving six Beltsville labs, the fate and effect of pathogens, parasites, and nutrients in manure that is land-applied, composted, or otherwise treated.
- Increasing the efficiency of phosphorus use by monogastric (one-stomach) animals through phytase enzyme feed additives and developing low-phytic-acid feed grains, to lessen excretion of unused phosphorus in manure.
- Assessing the effectiveness of riparian zones, vegetative buffers, and wetlands for nutrient removal.
- Developing a poultry litter treatment (alum) that protects environmental quality by reducing ammonia emissions and phosphorus solubility.
- Using algae as giant water filters to remove nitrogen and phosphorus from liquid manure from dairy barns.

- Seeking a better understanding of factors that trigger blooms of harmful algae, *Pfiesteria*, and related microbes.

- Developing special antibody probes to detect and identify *Pfiesteria*-like organisms and their toxins and explaining their effects on fish. In 1997, ARS and the University of Maryland co-sponsored a workshop to develop strategies to apply molecular technologies to *Pfiesteria* research.

- Documenting that oysters can harbor *Cryptosporidium parvum*, a dangerous protozoan parasite—the first time it has been found in a marine organism eaten by people. *C. parvum* is shed in the waste of livestock, wildlife, and humans.

- Using hydroponically grown fruits and vegetables to clean nutrients from fish wastes in aquaculture operations.

Just as water quality is important to natural environments and commercial fisheries, it is vital for successful aquaculture. A toxic algal bloom can wipe out a fish farm overnight. Aquaculture is an \$800 million to \$1 billion business in the United States—and growing.

ARS' expanding aquaculture program includes work in Delaware, West Virginia, Alabama, Arkansas, Louisiana, Mississippi, and Hawaii. It addresses water quality and environmental compatibility; fish health, growth, nutrition, reproduction, genetics, and production systems; and aquaculture food safety and quality. Expertise in aquaculture can be directly applied to research on agriculture's impact on water quality and fisheries.

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